

# **Nuclear Power's Resurgence: *An Option for the Northwest?***

Panel on Power Supply Possibilities:  
Emerging Solutions for Utilities

Northwest Public Power Association  
66<sup>th</sup> Annual Meeting  
Lake Tahoe  
23 May 2006

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Idaho National Laboratory

&

Vice President / President-Elect  
American Nuclear Society



# Nuclear in the news

The New York Times  
nytimes.com



washingtonpost.com  
**In the Northwest, Nuclear Power Takes a Hit**  
By Blaine Harden  
Washington Post Staff Writer  
Monday, May 22, 2006; A02

May 13, 2006

EDITORIAL

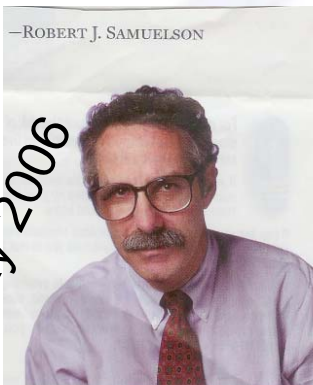
## The Greening of Nuclear Power

Not so many years ago, nuclear energy was a hobgoblin to environmentalists, who feared the potential for catastrophic accidents and long-term radiation contamination. But this is a new era, dominated by fears of tight energy supplies and global warming. Suddenly nuclear power is looking better.

"The replacement of Britain's nuclear power stations is "back on the agenda with a vengeance," Tony Blair, May 17, 2006

—ROBERT J. SAMUELSON

May 2006



Newsweek

News. Trends. Voices.

“We Americans want it all: endless and secure energy supplies; low prices; no pollution; less global warming; no new power plants (or oil and gas drilling, either) near people or pristine places. This is a wonderful wish list, whose only short-coming is the minor inconvenience of massive inconsistency.”

**INL** Idaho National Laboratory

washingtonpost.com

## Going Nuclear

A Green Makes the Case

By Patrick Moore  
Sunday, April 16, 2006; B01

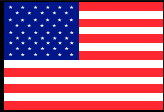








In the early 1970s when I helped found Greenpeace, I believed that nuclear energy was synonymous with nuclear holocaust, as did most of my compatriots. That's the conviction that inspired Greenpeace's first voyage up the spectacular rocky northwest coast to protest the testing of U.S. hydrogen bombs in Alaska's Aleutian Islands. Thirty years on, my views have changed, and the rest of the environmental movement needs to update its views, too, because nuclear energy may just be the energy source that can save our planet

NUCLEAR POWER  
AND  
SUSTAINABLE DEVELOPMENT










April 2006



# International nuclear electric production

		Number	% CF	% of Total Generation
	<b>United States</b>	103	92	20
	France	59	88	78
	Japan	52	70	25
	Russia	30	68	17
	Canada	21	64	13
	South Korea	20	92	40
	China	9	84	2
	Taiwan	6	88	22
	Mexico	2	79	5

# Current unit expansion in Asia/Europe

	Country	Operating Units	Number of Units Under Construction	Near-Term Plan (GWe)	By (year)
	India	14	8	29.5	2022
	South Korea	20	6	26.6	2015
	Russia	30	4	40	2020
	Japan	52	3	15	2025
	China	9	2	40	2020
	Ukraine	8	2	22	2030
	Pakistan	2	—	8.5	2030
	Iran	0	1	—	—
	Romania	1	1	—	—
	Finland	4	1 <sup>28</sup>	— <sup>160</sup>	—



# Drivers for additional U.S. nuclear capacity

- Safe
- Proven performance
- Cost effective
- Sustainable
- Energy security
- Base load generation/  
grid stability
- Emission-free
- International leadership





# Consolidation of nuclear ownership



Last 5 years

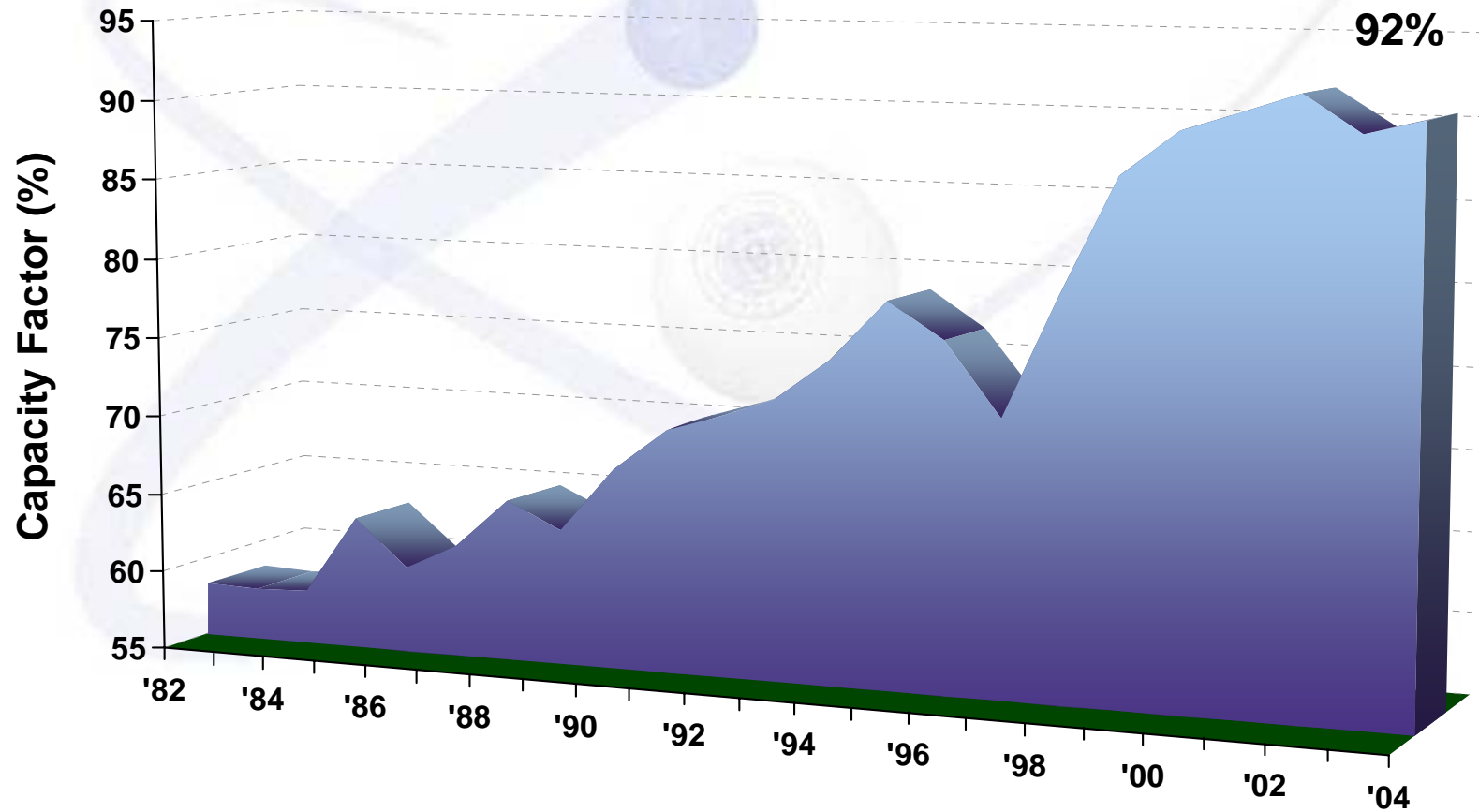
- **Substantial consolidation**
- **Top 10 operators have 61% of nuclear market**
- **Top 5 operators have 42% of nuclear market**

Consolidation  
of Ownership

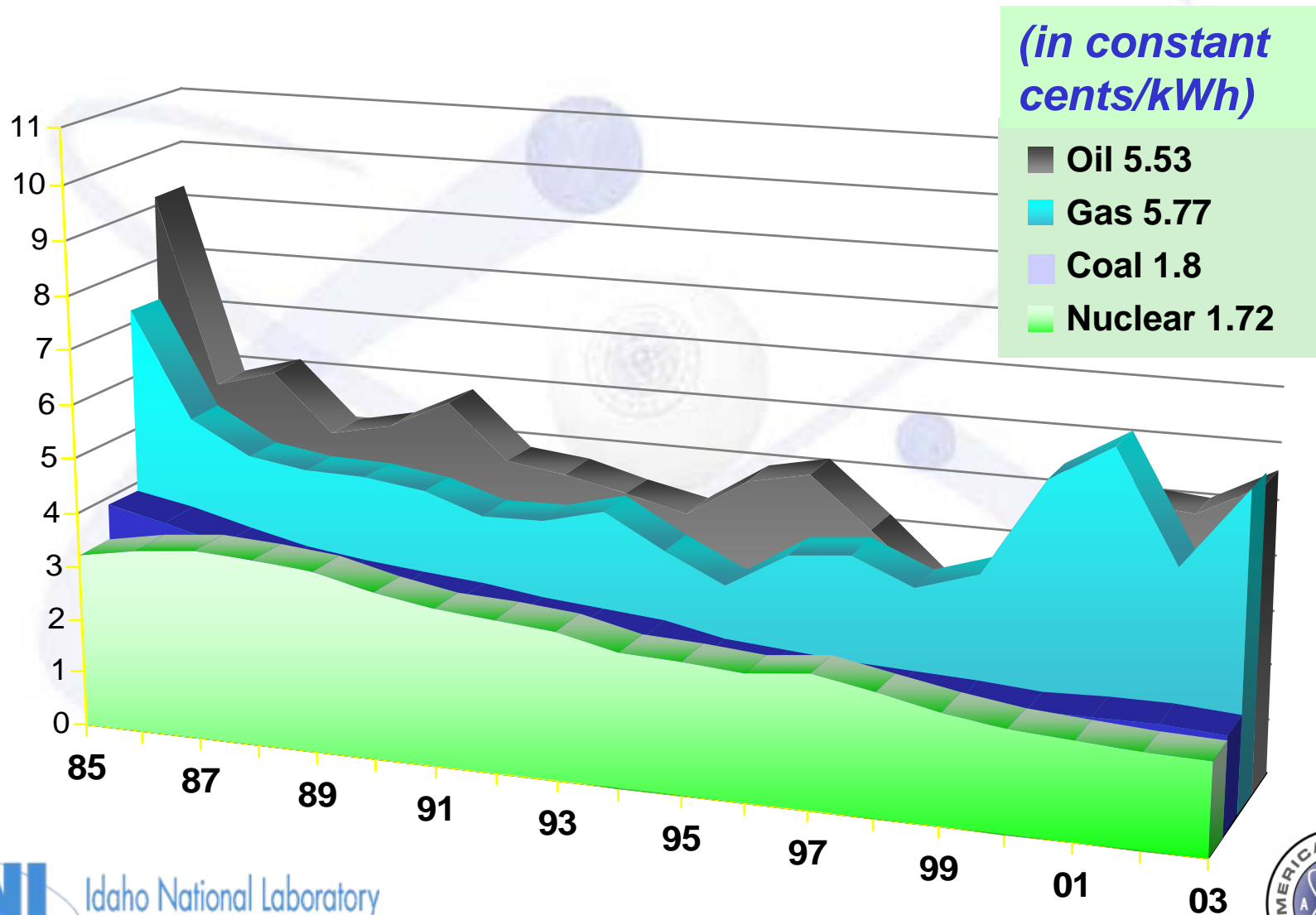
*resulted*

- Corporate M&A
- Asset sales by companies desiring to exit nuclear ownership

# Nuclear power's proven performance in US



# Currently the low-cost option



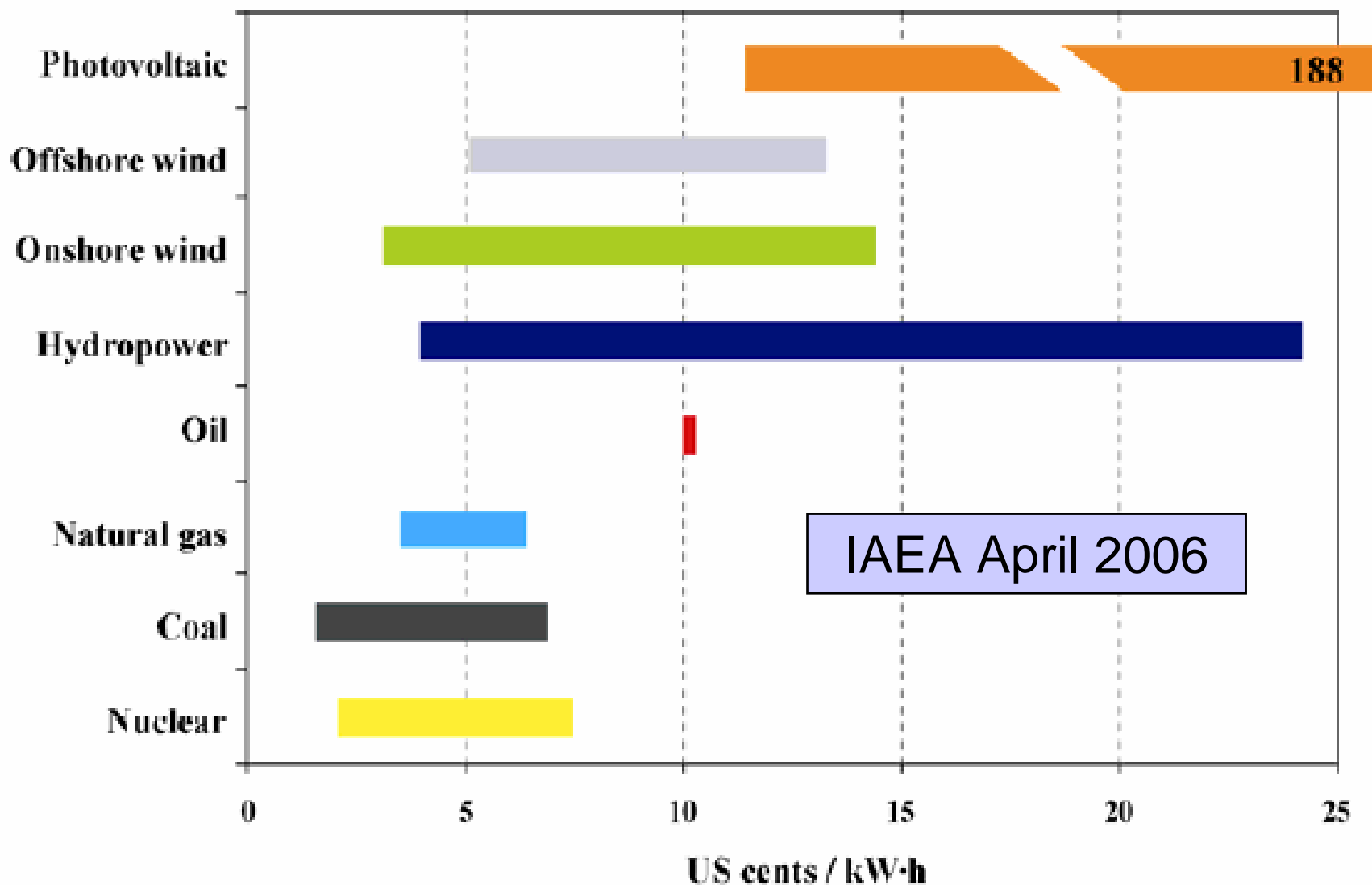
Idaho National Laboratory

Source: Federal Energy Regulatory Commission /EUCG





# Results of 7 recent forward cost studies

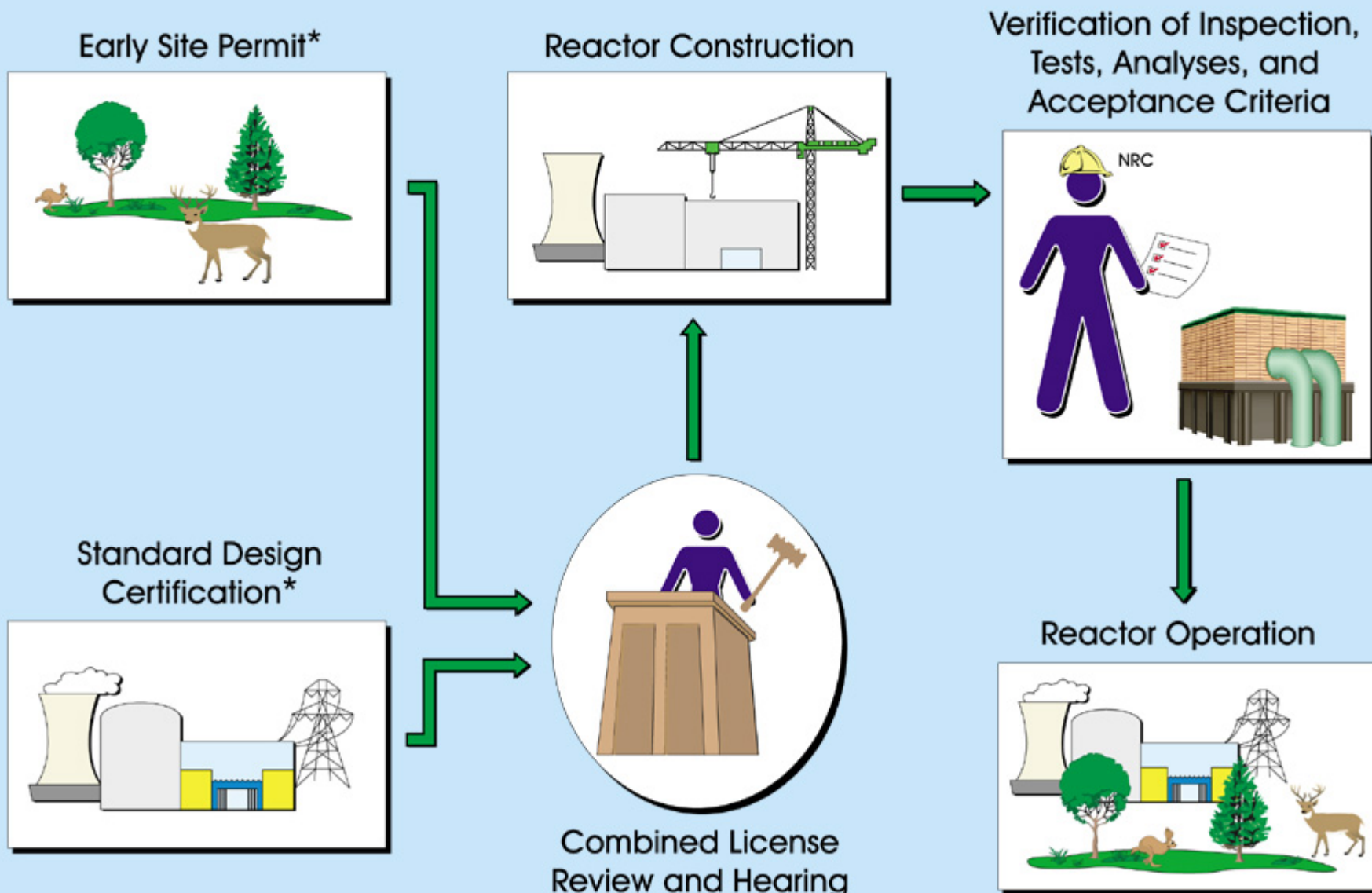




# Nuclear incentives provided by the Energy Policy Act of 2005 (EPACT2005)

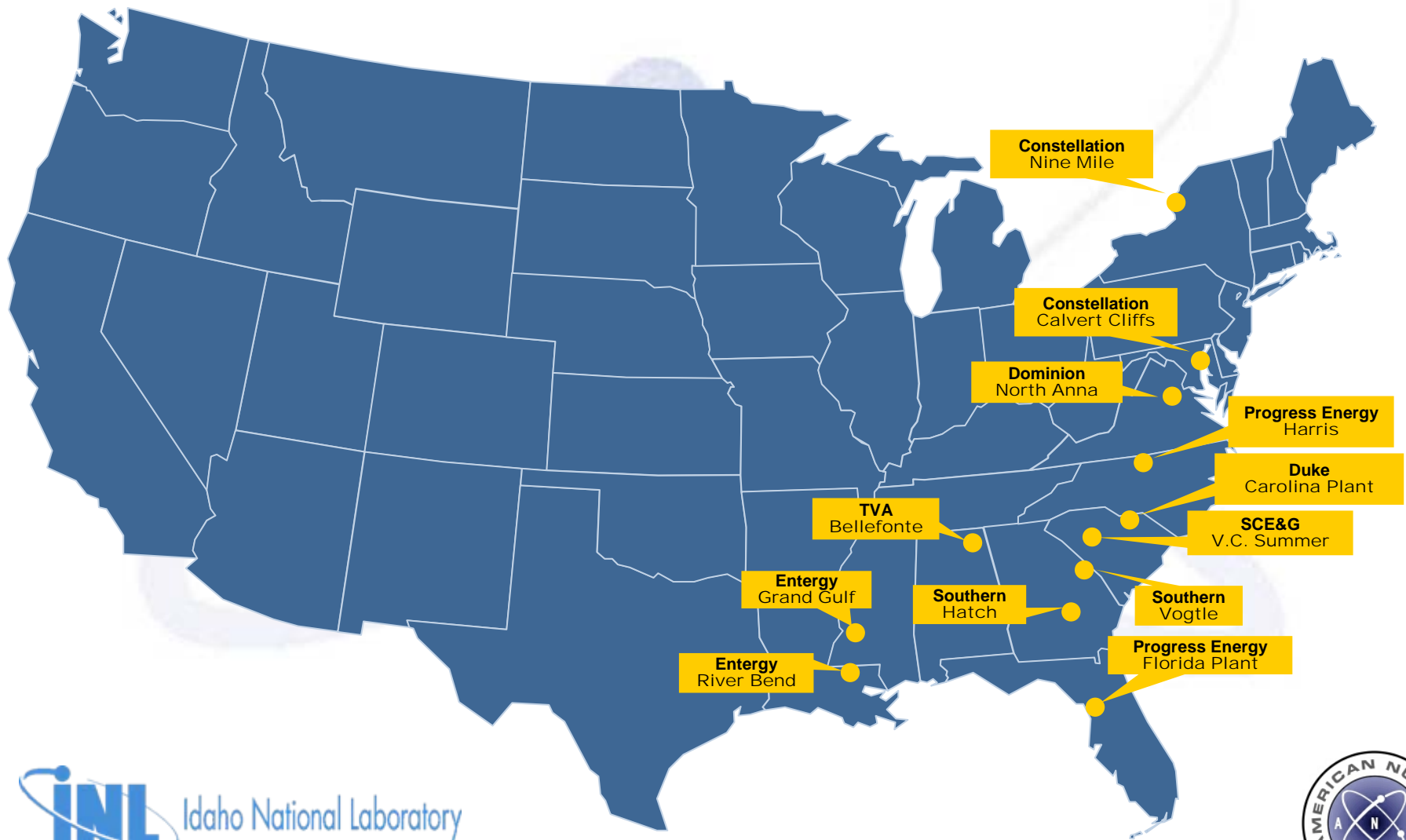
- Risk insurance
  - 100% for delays of first two plants up to \$500M each
  - 50% for delays for next four plants up to \$250M
  - No cost to government if licensing process works
- 80% loan guarantees (like FHA loan)
  - No cost to government if new plant operates
- Production tax credit of \$18/MWH
  - For first 6,000 MWs of new plants
  - For eight years only, \$125M cap per plant
  - Same as windmills have had since 1992

# Combined Licenses, Early Site Permits, and Standard Design Certifications



\* or equivalent process

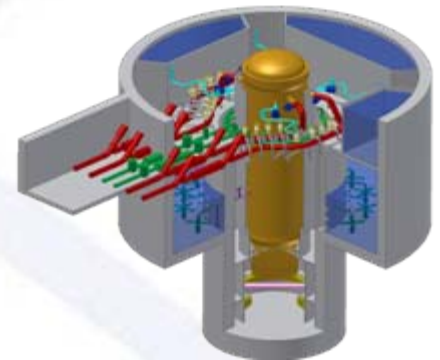
# First movers for new nuclear plants



# New designs available today—*Generation III+*

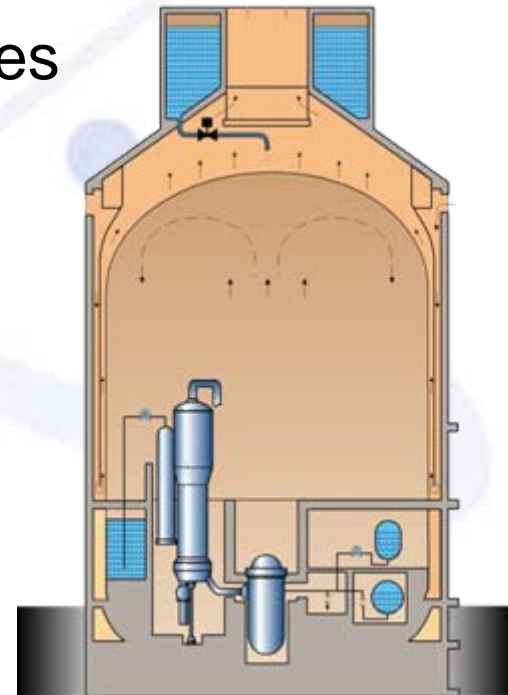
## Advanced Light Water Reactors (ALWRs)

- Standardized designs based on modularization producing shorter construction schedules
- Passive or redundant systems to enhance safety
- Easier to protect from terrorist attacks



# Westinghouse

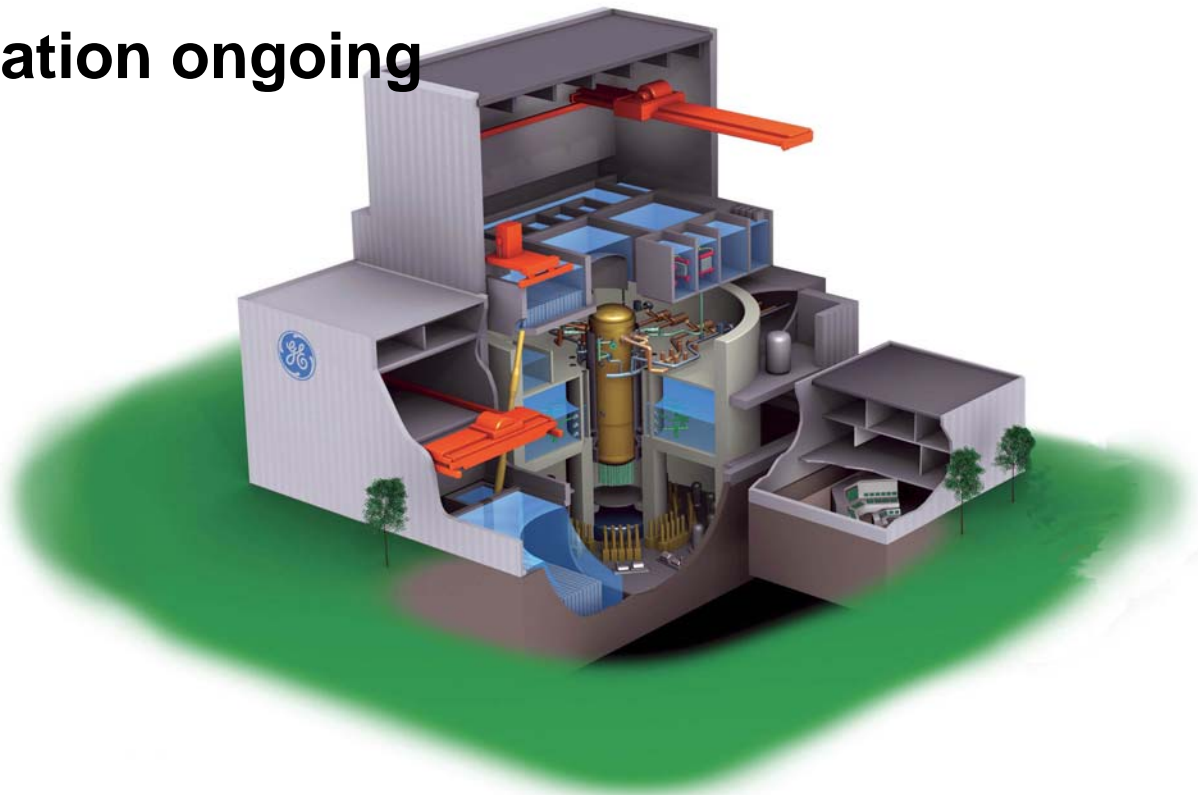
- **AP 1000  
(1,148 MWe)**
  - Passive safety systems permit simplification and improve safety
  - **NRC design certification** provides regulatory certainty:
    - AP 600—December 1999
    - **AP 1000—Early 2006**





# General Electric

- **Economic Simplified Boiling Water Reactor ESBWR (1,550 MWe)**
  - Passive safety systems
  - **Design certification ongoing**

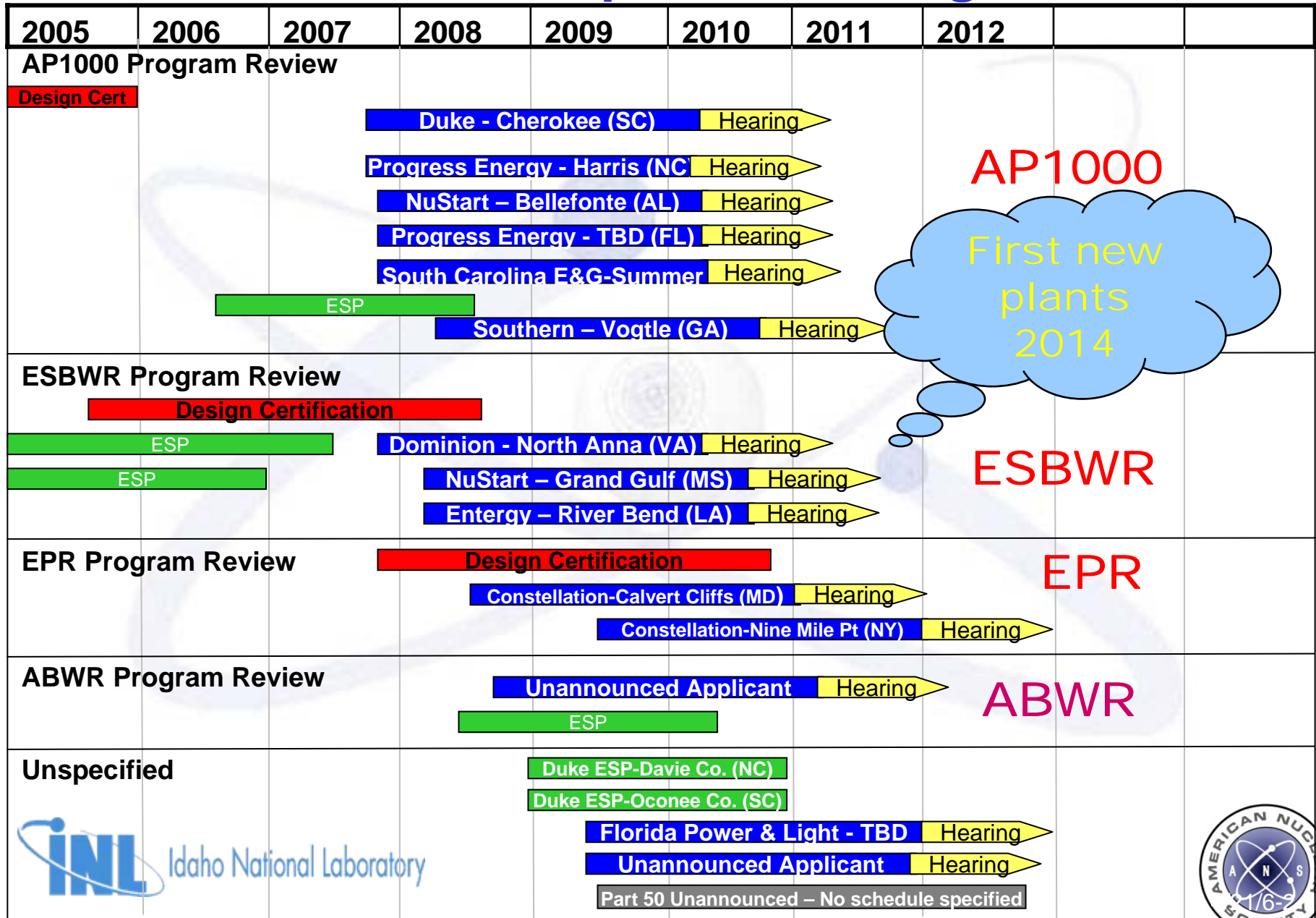


# AREVA/Framatome ANP

- **Evolutionary Power Reactor EPR (1,600 MWe)**
  - Redundant safety systems
  - Preparing for certification
  - European version under construction in Finland
  - **Design certification review to start in 2007**



# NRC's estimate of new plant licensing schedule



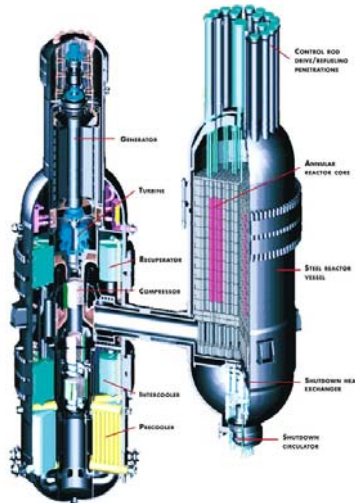
# High-temperature Gen IV reactors may have multiple applications



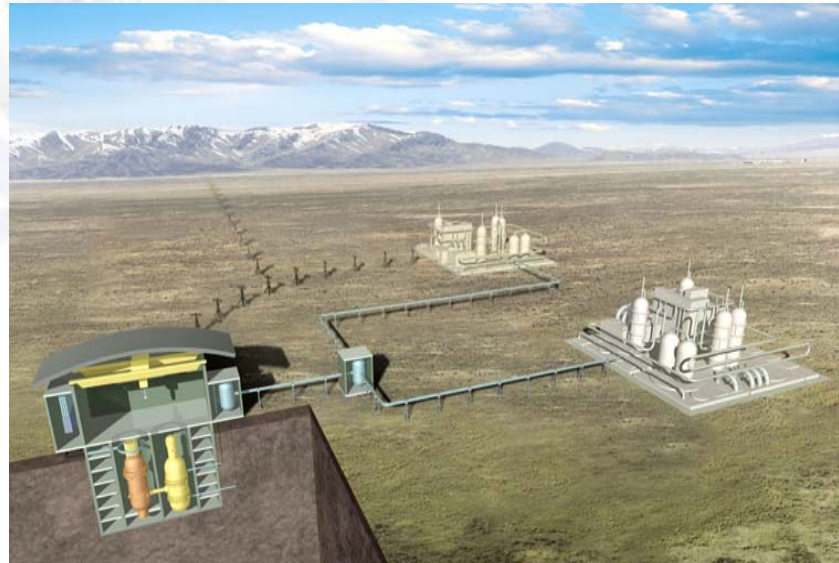
**PBMR**  
165 MWe

*The  
Freedom  
Reactor*

**GT-MHR**  
286 MWe



- NGNP technology not fixed until 2011
- Strategy due to Congress 8/8/08
- Idaho National Laboratory to provide support
- Flexible licensing strategy



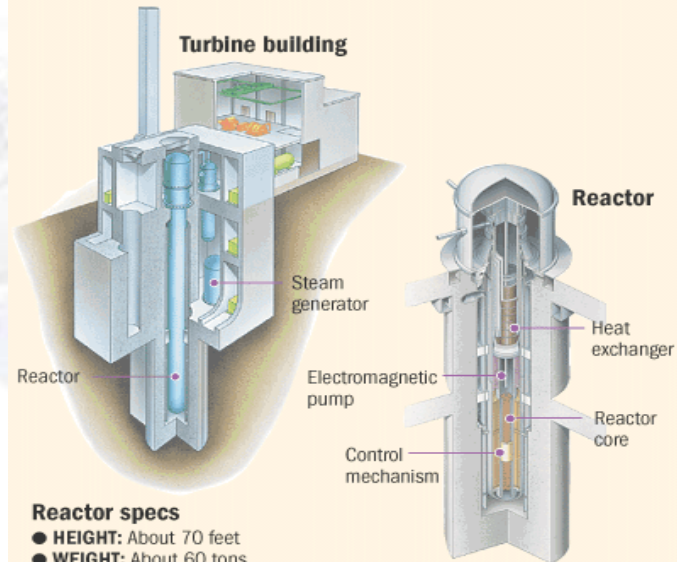


# Toshiba 4S sodium cooled reactor targets small niche markets

- **10 MWe**
- Designed for remote locations without much infrastructure
- **No refueling over 30 year lifetime**
- Reactivity control – movable reflectors
- Passive safety
- **NRC pre-application review pending**
- **Galena, Alaska?**

## Nuclear power for rural villages

Toshiba is proposing a small modular nuclear reactor to supply power for Galena, a Yukon River town of 713. It has yet to be constructed, but would likely consist of a 70-foot tube with a garbage-can-sized uranium core at the bottom and a liquid metal heat exchanger in the upper section. The assembly would be buried in a concrete silo. The slow-burning uranium would last 30 years, powering steam turbines to create electricity. Conceptual drawings of the plant are below.

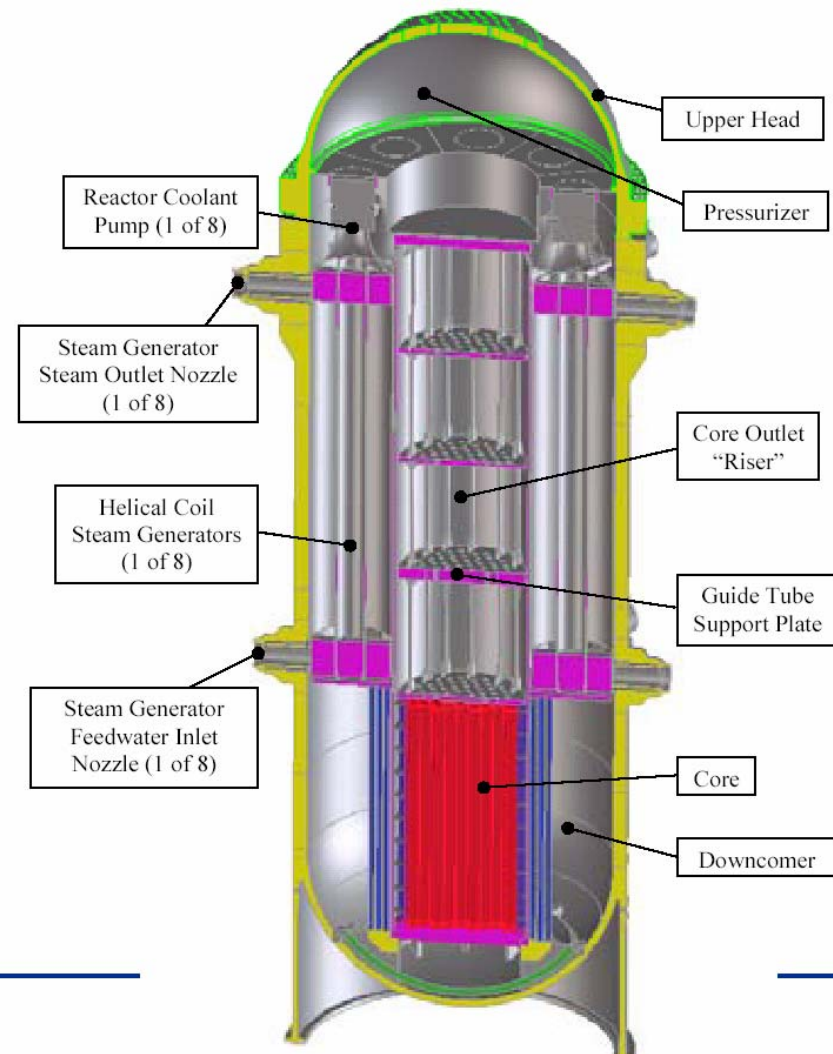


### Reactor specs

- **HEIGHT:** About 70 feet
- **WEIGHT:** About 60 tons
- **ELECTRICAL PRODUCTION:** About 10 megawatts. A typical Lower 48 nuclear plant is 1,000 megawatts or more. When the fuel is spent, the core can be removed and recycled.
- **ELECTRICAL COST:** The plant could generate electricity at 10 cents a kilowatt hour, which is slightly more than in Anchorage or Fairbanks, but a half to two-thirds the current cost in Galena.
- **CONSTRUCTION:** The modular plant is constructed in a factory and could be delivered by barge to the site. Components are small enough to be delivered by truck or helicopter.
- **PROJECT COST:** \$20 million. Toshiba says it will install the Galena reactor free, as a demonstration project.
- **NUMBER OF EMPLOYEES:** The reactor has no operator or maintenance personnel; the steam generator would probably require the same number of people as the diesel-powered plants.

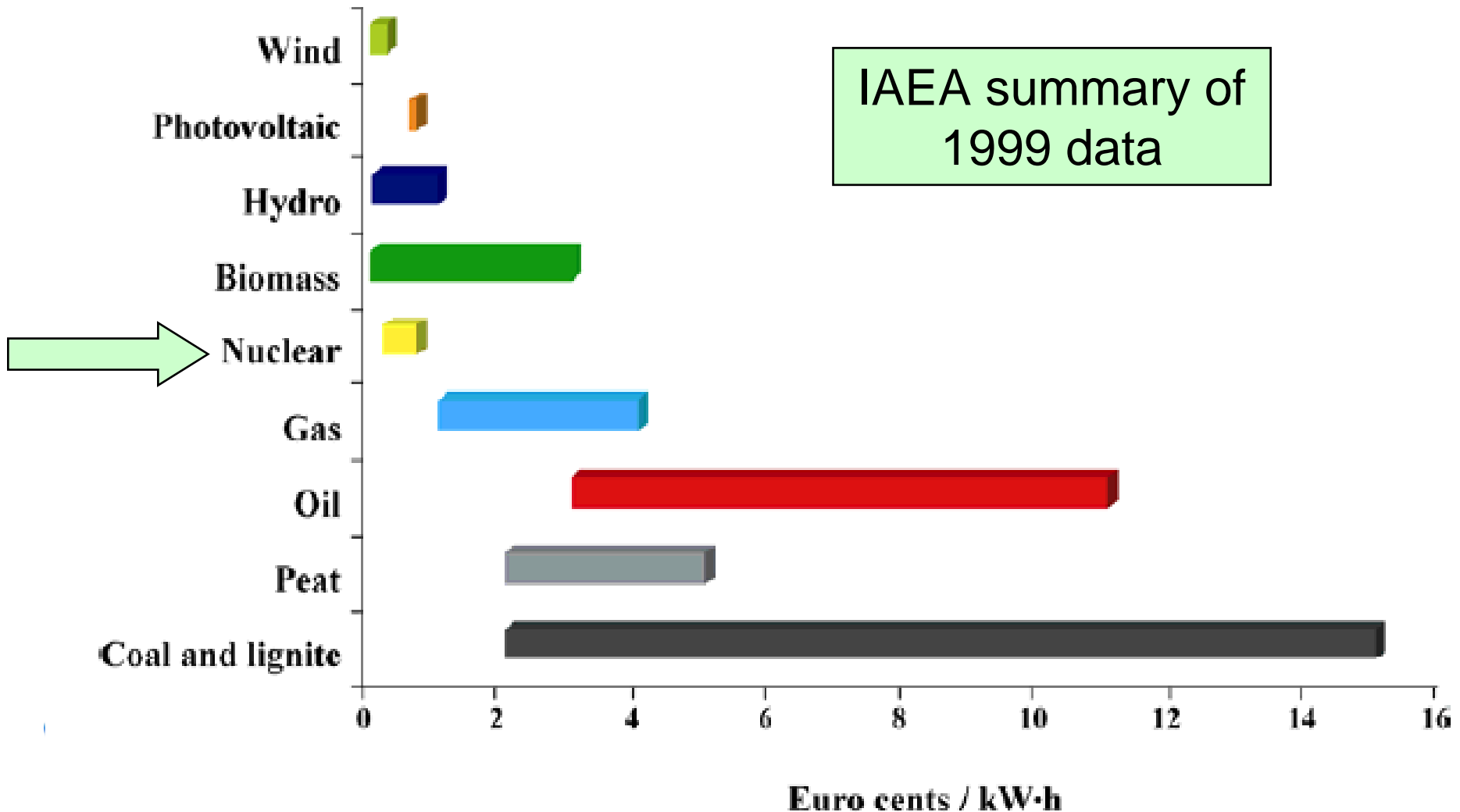
# [Westinghouse] International Reactor Innovative and Secure (IRIS)

- Integral LWR (335 MWe)
- Safety by innovative design features and passive safety systems
- 3 - 4 year core
- Modular fabrication and construction
- Spherical Containment
- Generation IV Objectives
  - Proliferation Resistance
  - Enhanced Safety
  - Improved Economics
  - Reduced Waste
- **NRC pre-application review underway**





# External cost of power generation is a measure of a technology's “greenness”



# Is nuclear an option for the Northwest?

- Nuclear plants should be run by experienced operating companies
- They are most economical in large sizes (>1000 MWe)
- They provide reliable base-load electricity
- There is competition for scarce resources
  - NRC licensing review
  - Components
  - Skilled labor
- Sites?